25 years X-ray observations of the HBL object 1E 1207.9+3945

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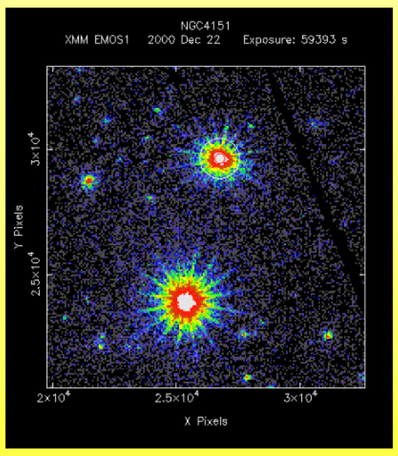
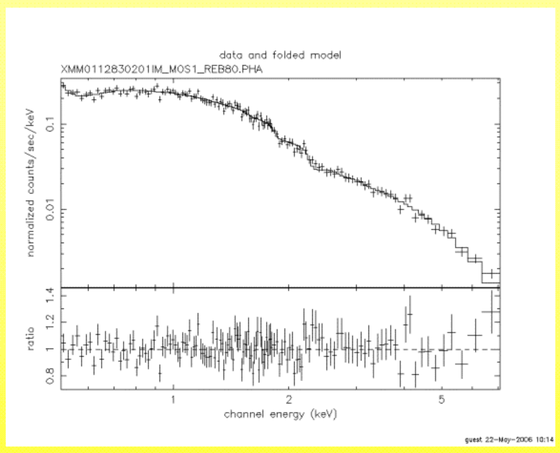
Introduction:

1E 1207.9+3945 is one of the X-ray selected BL Lacertae objects of the *Einstein* Medium Sensitivity survey. According to the unified schemes BL Lac objects, together with Flat Spectrum Radio Quasars, constitute the class of blazars and represent radio-loud AGN observed in a direction very close to the axis of a relativistic jet outflowing from the inner nuclear region. 1E 1207.9+3945 was discovered as a serendipitous source in the field of view (about five arcminutes north) of one of the most popular and most intensively studied AGN in the sky, the Seyfert galaxy NGC 4151: for this reason it has been observed repeatedly by all the X-ray telescopes that have operated since the *Einstein* observatory. Despite that 1E 1207.9+3945 is a relatively high redshift source (z=0.615) HST detected the host galaxy, which appears to be a very bright elliptical galaxy (M_R=-24.4). 1E 1207.9+3945 belongs to a sample of blazar sources selected for a *Swift* key project of observation: it was observed on 26 December 2005 with both te XRT (X-Ray Telescope) and UVOT (UltraViolet-Optical Telescope) instruments. The preliminary results coming from XRT observation are reported and compared with those coming from a longer (59 ks) XMM-Newton observation carried out on 22 December 2000. We finally report the long term X-ray light curve and the Spectral Energy Distribution (SED) of the source: the synchrotron radiation component peaks in the X-ray band, so the source is classified as a HBL (High-energy peaked BL Lac).

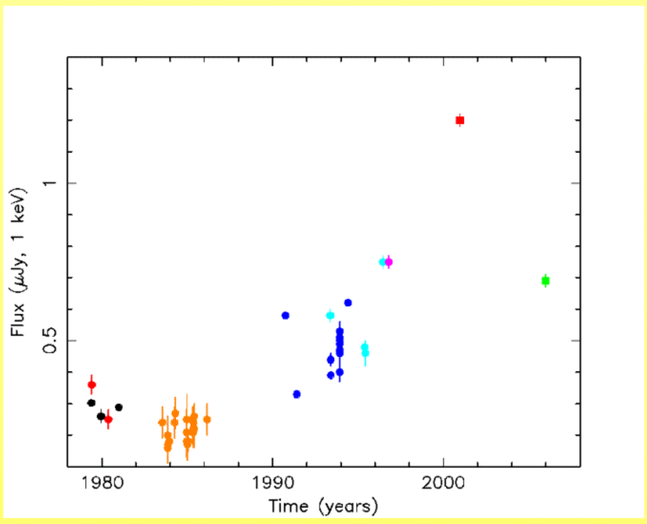
XMM-Newton





XMM-Newton observed 1E 1207.9+3945 with all EPIC-MOS cameras operating in Full Frame mode and with the Medium filter. Data were reduced using the Science Analysis System (SAS) v. 6.5.0. Photons were extracted within an annular region in order to avoid pile-up effects: the inner radius is 10″, the outer one is 40″. The background spectrum was extracted within a nearby source-free circular region of size comparable to the source region. An energy range 0.5-10 keV was used for spectral analysis. We fitted data using a log-parabolic model fixing the hydrogen columns density to the Galactic value (N_H=2.0 10^{20} cm^{-2}) and we found a significant curvature value (b=0.24 ± 0.05).

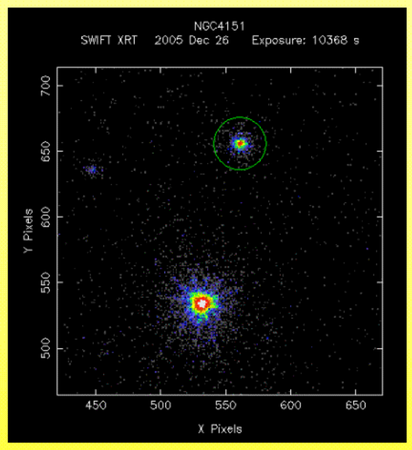
X-ray light curve

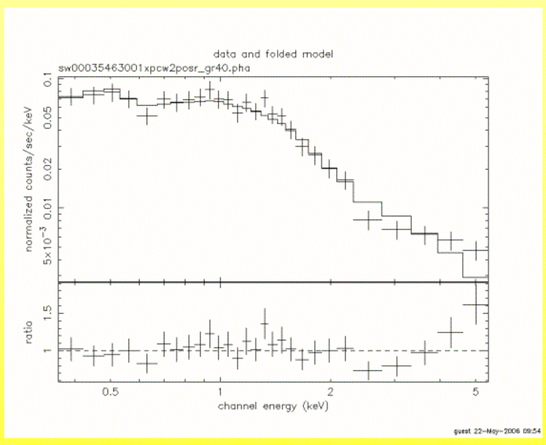


The X-ray light curve covers a very long time interval: in more than 25 years, 1E 1207.9+3945 reveals sensible flux variations (nearly a factor of five) at the energy of 1 keV. The source appears to go through a period of intense activity particularly over the last few years in comparison to an earlier, more quiescent state.

Einstein IPC	(black)
Einstein HRI	(red)
EXOSAT CMA	(orange)
ROSAT PSPC	(blue)
ROSAT HRI	(light blue)
BeppoSAX MECS	(magenta)
XMM-Newton MOS	(red)
Swift-XRT	(green)

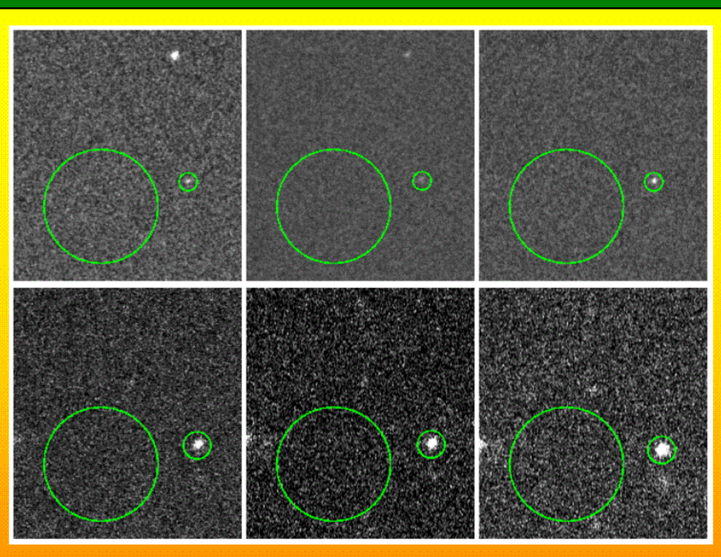
Swift XRT





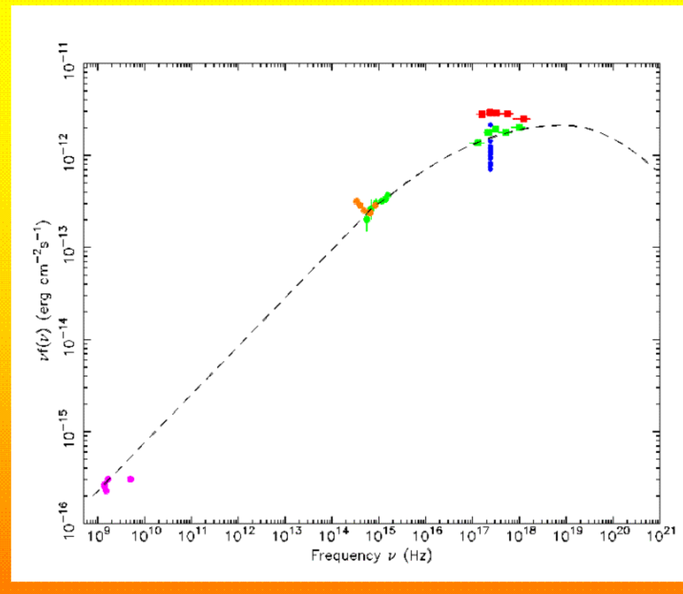
XRT observation was carried out in the Photon Counting (PC) readout mode: data were reduced using the XRTDAS software developed at the ASI Science Data Center and distributed within the HEAsoft 6.0.5 package by HEASARC. The source count rate was low enough to avoid photon pile-up in the central pixels of the PSF, so the spectral data were extracted in a circular region with a 20 pixels (47″) radius; background was estimated in a nearby source-free circular region of 50 pixels radius. Spectral analysis was carried out in the range 0.3 – 10 keV: even in this case we fitted data using a log-parabolic model and Galactic N_H and found a significant curvature (b=0.30 ± 0.15), in agreement with the XMM-Newton observation. A possible hard tail is observed at high energies (E > 4 keV).

UVOT



The UVOT instrument obtained series of images in each of the lenticular filters V, B, U, W1, M2, W2 . The data analysis was performed using dedicated tasks from the HEAsoft 6.0.5 package. Each series was summed up with UVOTIMSUM to obtain a single frame in each filter. Photometry was then performed using UVOTSOURCE. Counts were extracted from a 4″ radius aperture (V, B, U) and 6″ aperture (W1, M2 , W2): a larger radius was used for the UV filters due to a relatively wider PSF; the background subtraction was performed selecting a 20″ radius region offset from the source. Then count rates were de-reddened using a value of 0.03 mag (Schlegel et al. 1998) and converted to specific fluxes (erg cm^{-2} s^{-1} Hz^{-1})

SED



VLA	(violet)
SDSS	(orange)
XMM-Newton	(red)
Swift UVOT	(green)
Swift XRT	(green)
ROSAT PSPC	(blue)
Einstein IPC	(blue)

The Spectral Energy Distribution of 1E1207.9+3945 follows the characteristic trend of HBL sources, that is a Synchrotron radiation component covering an extended frequency interval from radio to X-ray, and peaking in the X-ray region; a second component at higher energies, due to Inverse Compton scattering, has not yet been detected. In the infra-red part of the spectrum, SDSS data suggest the probable sign of the host galaxy. A single Synchrotron component fits well the spectrum all over the covered frequencies.